The following were elected members:

Asa Whitney, George Whitney, John R. Whitney, Edward Clarke, Clarence H. Clark, Frank H. Clark, Theodore H. Morris, O. Nichols Beach, James N. Whelen, Wm. A. Whelen, Alexander Whilldin, Orlando Crease, Andrew I. Sloan, D. Murray Cheston, M. D., Edw. C. Knight, Frank Hazeltine, Wm. R. White, Jr., Daniel H. Rockhill, Franklin S. Wilson, Rev. J. G. Ralston, and Clarence S. Bement.

On favorable report of the Committee, the paper of Prof. Cope, read May 14th, was ordered to be published in the Journal.

On favorable report of the Committees, the following were ordered to be published:

Notes on MICROPUS (LYGARUS) LEUCOPTERUS, Say, ("The Chinch Bug.") With an account of the great Epidemic Disease of 1865 among Insects.

BY HENRY SHIMER, A. M. M. D.,

Mount Carroll, Illinois.

During the few years preceding the summer of 1865, I was very favorably located for observing the great grain enemy of the West—"The Chinch Bug"—in the midst of one of the most important agricultural regions in the valley of the Mississippi, and with some personal interest in that direction. I gave the subject the most thorough investigation in all its bearings, during a period of several years, and therefore believe that I observed some facts worth recording, although it is an old subject—one upon which much has been written—much, however, upon mere conjecture or ephemeral observation, without sufficiently thorough investigation; hence, often widely departing from the truth. (See the various printed reports.)

With the wide-spread destruction that followed the rise and progress of the "Chinch Bug," most western men are quite well acquainted, and many in pocket sadly familiar. Under the genial influence of a favorable clime, the "chinch bug" attained the maximum of its development in the summer of 1864, in the extensive wheat and corn fields of the valley of the Mississippi; and in that single year, three-fourths of the wheat and one-half of the corn crop were destroyed throughout many extensive districts, comprising almost the entire North-west, with an estimated loss of more than one hundred millions of dollars in the currency that then prevailed; which, if thus continued for one hundred years, and estimating the value of money at the legal rates of our State, annually, would amount to the enormous sum of one hundred and thirty-seven thousand seven hundred and ninety-six millions of dollars lost to the farming community alone. By estimating the effect of this loss upon the various associated interests of the nation, and by observing the tendency of this insect, unchecked, to spread everywhere in this our rapidly developing country, we can easily see that it would fall short of the true estimate to place the entire loss to this continent, if uninterruptedly continued for one hundred years, equal to a sum sufficiently vast to engulf the present wealth of the world, and all from an apparently "insignificant insect"—a "bug," popularly unworthy of notice, as a single specimen.

In view of these great facts, I gave the subject my most untiring attention; the insect enemies of the chinch bug were carefully watched, everything bearing upon it was noted, hoping that some practical method might be developed, or some enemy discovered, that would lead us to hope for its ultimate control, if not destruction.

The ravages of the "chinch bug" have been marked with varying paroxysms, from year to year, for a long time, among the records of which it will be seen that Mr. Walsh (Transactions Ill. Agricultural Society,) estimates the loss in

Illinois alone, in the year 1850, to have been four millions of dollars. What fatality produced the subsequent paroxysms in its development, and so greatly diminished its destructiveness for several years, so that it scarcely excited much attention, it was not my province to behold; and I believe no record has been made.

The pleasant dry summers, and the snowy protection of the accompanying winters for several successive years, so fostered these insects that the harvestmen found them in every field in unnumbered millions in 1864, blasting the fairest prospects of the bone and sinew of the land. It was my privilege, in the spring of 1864, to observe the parent insects fulfil the principal office of nature by propagating their species, and quietly die from natural laws after the great object of their being was accomplished. Day after day, it was the greatest pleasure of all my numerous entomological observations, in a scientific point of view, while I deplored their devastations, to mark the progress of the vast hosts of their offspring towards the imago state everywhere around me. From the platforms of the grain reapers in the prairie harvest fields, it would have been no difficult task to gather these little insects by bushels; and when the dry straw of the wheat fields no longer afforded them nourishment, they took up their line of march for the corn-fields, according to their usual well-known custom, on this occasion almost literally covering the ground in many places; sometimes gathering together into piles, and here casting their skins. This, being observed carelessly by farmers and others, leads them to declare that "the 'chinch bugs' were destroying each other," "that they were dying," &c.; the dry shells remaining behind being mistaken for the insect itself.

I have seen the columns of these insects a full week on the march across meadows and pasture fields from the wheat to the corn field; and have even seen them swim a small stream of water that crossed their line of march. In former years the few border rows of corn, together with the "fox-tail grass," (Setaria,) carelessly left among the corn in cultivating, usually satisfied them. This latter grass is usually attacked in preference to the corn.

In 1864 whole corn fields were overrun by them; the stalks, especially below the ears, blackly covered through the day, were bleeding and literally raw from their numerous punctures. At length, when they had attained the perfect state during the warm part of bright sunny days, they took to their wings, and literally filled the atmosphere, not much unlike an April snow storm. This interesting phenomenon induced many to believe that they were leaving the country; but it was for an entirely different purpose—that of choosing their mates—for they never fly except in the love season. After a few days they might be found paired in corn fields, and other proper breeding grounds producing a new generation. At this time, in the month of August, 1864, my attention was very favorably directed to a small field of tender, thickly-sown corn for fodder, where they congregated in immense numbers, and continued until the frosts of autumn had killed the corn that they did not consume, and developed their progeny in unnumbered millions. During the day they resorted to the stalks of corn to feed upon the juice, but they passed the night usually upon the ground.

The two principal insect enemies that I observed among this autumn brood were a very common species of "lady bird," (*Hippodamia maculata*,) and a species of the "golden-eyed fly," (*Chrysopa Illinoiensis*, Shimer, Proceedings Entomological Society, vol. iv., p. 208). Both these enemies were very numerous—especially the former, which could be counted by hundreds on every square yard of ground after shaking the corn; but the chinch bugs were so numerous that these hosts of enemies made very little perceptible impression among them. After the early autumn frosts, they left their feeding grounds, on foot, in search of winter quarters; none could be seen on the wing, as at harvest time, above alluded to. For a winter retreat, they resorted to any convenient shelter they might chance to find, as long grass, weeds, boards, pieces of wood rails, fallen tree leaves, &c., &c.

In January, 1865, I next examined their condition; those that I found in the sheathes of the corn leaves above the snow, and had been thus exposed during the previous severe weather—when, for several successive days, the thermometer was 15°—20° below zero—were invariably found dead, without exception, and those beneath the snow were alive. This observation was made in the common farm cornfields, as they might be found anywhere all over the wide country; for in autumn the chinch bugs remained in great numbers in the corn husks, and under the sheathes of the blades, as well as in other winter retreats. Upon various occasions, as the winter advanced, I brought in corn husks, filled with ice, enclosing the chinch bugs in the crystallized element; when the ice was thawed, they were able to run, apparently unaffected by that degree of cold. It is therefore proved that these insects possess vitality sufficient to withstand the effect of a temperature below the freezing point, and perhaps below zero, as must have been their condition in these ice-bound husks; but when in the open air, exposed to the sweeping prairie winds, 15 or 20 degrees below zero, for a long time, they succumb to the cold.

March 7, 1865. The snow having cleared off from the ground, I examined the condition of a host of these chinch bugs that had chosen for their winter covering cord-wood sticks, lying on the ground, entirely surrounded by frost and ice; of these, 20 per cent. were living; those that were more fortunate in their selection of winter quarters fared much better. From a single handful of leaves, picked up at one grasp from beneath an apple tree, I obtained 355 living and 312 dead chinch bugs; and of their lady-bird enemies that had entered the same winter quarters with them, 50 were living and 10 dead Of these chinch bugs, I placed a number in comfortable quarters in the house, in a small paste-board box—not in a stove room—together with some coleopterous insects, casually gathered among the chinch bugs; after one month, I found the latter all dead and the former living.

The entire month of March was rain, snow, thawing, freezing, alternately, seeming to be very uncomfortable for any living creature to remain out of doors with so poor a shelter, and on top of the ground.

April 1—6. I again made repeated examinations of these chinch bugs in their winter quarters, and found about the same proportion of them living as noted on the 7th of March. At this time they wandered away, on foot, from their winter quarters, in quest of food.

May 16, 1865, was a delightful, mild, bright, sunny, summer-like day; and I again, for the last time, observed the same highly-interesting phenomena, which I have noticed above as occurring after the harvest of 1864—the atmosphere swarming with chinch bugs on the wing. This is their spring; that was their autumnal nuptial season—their season of love. These remarkable little creatures prefer to conduct their courtships under the searching gaze of the noonday sun, instead of at the midnight hour. They were so numerous, alighting on the pavements in the village, that scarcely a step could be taken without crushing many of them under foot. In a few days, they had all disappeared; their breeding grounds were chosen, where they could be found in great numbers, often in pairs. I first noticed this disposition of the chinch bug to take wing under the promptings of the love passion, about six years ago, in their autumnal love season. At no other time, save their love season, twice a year, have I ever seen one chinch bug flying. It is quite remarkable that the winged imago, under no other circumstances, will even attempt to use its ample wings. No threatening danger, however imminent, whether of being driven over by grain-reapers wagons, or of being trodden under foot, &c., will prompt it to use its wings to escape. I have tried all imaginable ways to induce them to fly, as by threshing among them with bundles of rods or grass, by gathering them up and letting them fall from a height, &c., but they invariably refuse entirely to attempt to use their wings in escaping from danger. The love emotion alone makes them conscious that they are in possession of wings.

May 18th and 19th.—I find the chinch bugs very abundant in the fields of

young spring wheat, barley, &c., under loose clods of earth, old cornstalks, and about the roots of the grain, in cracks of the ground, &c. In some badly affected fields a dozen or more to every wheat stalk.

May 26th.—The chinch bugs are just beginning to lay their eggs, and some fields of wheat are greatly damaged already from the feeding of the perfect insect. The stalk at the surface of the ground is black from their punctures, the sheaths of the outer leaves being scarred and dead; the tops are pale yellow, and often withering; many stalks are as dead and dry as hay. I saturated some saw dust with coal tar, and mixed some quick lime among it, so that it might be in a good condition for handling, and sowed it thickly broadcast over a portion of my wheat field where the bugs were very numerous.

May 27th—29*th.*—I find the chinch bug eggs more abundant, mostly on the roots and stalks beneath the ground, sometimes in loose clusters of a dozen or more. They are on the roots, where they cross the numerous cracks in the ground; less frequently on the stem, at the surface of the ground. These eggs are scarcely visible to the naked eye. Many of the bugs are in copulo, with their heads in opposite directions; the females are the larger, dragging the males when alarmed. The bugs refuse to leave the part of the field where I sowed the tarred sawdust, so there is but little hope of driving them from their once chosen grounds by the reasonable application of strong smelling drugs.

June 10th.—I saw the first larvæ chinch bugs of the season, small red fellows, on the roots; eggs very numerous. Actually saw a female laying an egg on my hand, under a slight pressure.

The egg is elongate ovate, about four times as long as wide (as nearly as I could determine with fine mathematical instruments ·04 in. long and ·01 in. wide; of course this lacks the precision of a micrometer measurement) pale amber white when first laid, but becoming of a reddish color, like the young, as the season of incubation advances. A moderate amount of moisture is necessary to the development of the egg. Those put into a pasteboard box in my room did not hatch, but shrivelled or dried up.

June 17th.—Millions of very small red young chinch bugs; they are on the roots, in crevices, and on the stems, under clods, &c., beneath the ground. The egg-laying season has terminated; the parent bugs are principally dead. Those that died before the rains a few days ago are mouldy; others, in great numbers, in many places covering the ground, apparently are just dead. During the past month, as I learned from many observations, they passed most of their time beneath the ground, in the crevices, &c., so that although millions of them existed in every field, a casual observer would believe that but a few were there. But their work being finished, they came out to die. A very few imago, scarcely one of a hundred, yet remain alive.

July 1st.—I ploughed a few acres of badly affected barley beneath the ground, to see what effect it would have upon the bugs, hoping that it might destroy them, and thus save the adjoining corn.

July 16th.—A farmer four miles from here informed me that a black coleopterous insect was destroying the chinch bugs on his farm very rapidly; and although I found his supposition to be an error, yet I found many dying on the low creek-bottom land from the effects of some disease, while they are yet in the larvæ state—a remarkable and rare phenomenon for insects thus in such a wholesale manner to be dying without attaining their maturity, and no insect enemy or other efficient cause to be observed capable of producing this important result.

July 22d.—Saw the first matured young chinch bug observed this year. Wings perfect, body pale reddish white, fresh from its last moulting. It is just 57 days from the time I saw the first egg, and 42 days since I saw the first larva.

On the low grounds the young chinch bugs are all dead from the disease above alluded to, and the same disease is spreading rapidly on the hills and high prairies.

The weather has been very wet since the first of July, and the barley above alluded to, which I ploughed beneath the ground, did not die, but assumed a yellow, sickly appearance; in its shady, compressed, unnatural position, the ends of the heads project from beneath the furrows. The chinch bugs also remained alive for a time, but feeding on the sickly grain and shaded from the sunlight, what little we had, were attacked by disease in the same manner and about the same time as those on the low creek-bottom lands, meeting very rapidly the same fate, so that very few of them ever found their way to the neighboring corn.

July 28th.—In the fields where 60 days ago I saw plenty of eggs, and 42 days ago an abundance of young chinch bugs, the imago are beginning to develop quite plentifully. Great numbers, in all stages of their development, are dying of the prevailing disease.

Aug. 8th.—The majority of the chinch bugs yet alive are in the imago state, but they are being rapidly destroyed by the prevailing epidemic disease, more fatal to them than the plague or Asiatic cholera ever was to man, more fatal than any recorded disease among men or animals since time began. Scarcely one in a thousand of the vast hosts of young bugs observed at the middle of June yet remain alive, but plenty of dead ones may be seen everywhere, lying on the ground, covered with the common mould of decomposing animal matter, and nothing else, even when examined by the microscope. Even of those that migrated to corn fields a few weeks ago, in such numbers as to cover the lower half of the corn stalks, very few are to be found remaining alive; but the ground around the base of the corn hills is almost iterally covered with their mouldering, decomposing dead bodies. This is a matter so common as to be observed and often spoken of by farmers. They are dead everywhere, not lying on the ground alone, but sticking to the blades and stalks of corn in great numbers, in all stages of their development, larva, pupa and imago.

Aug. 22d.—It is almost impossible to find even a few cabinet specimens of chinch bugs alive, so that I am quite sorry that I did not secure a large supply of specimens while they were so numerous, in former years; for it really appears quite probable that even cabinet specimens will be hard to secure, whereby to remember the fallen race of the unnumbered millions of former years.

Sept. 13th.—After a whole day's searching in the corn fields, I have just been able to find two larvæ and a few imago chinch bugs, against the great numbers above alluded to in the corn about this time last year.

From this series of investigations I have learned that the parent chinch bug is occupied about 20 days in laying her eggs, during which time she probably lays about 500 eggs, and then dies; although careless observers and theorists suppose that she lays many more eggs, and that she continues to lay eggs all summer; also that the egg is about 15 days in hatching, that in from 57 to 60 days after the egg is laid the imago appears, and that there are *two* distinct broods in a season, and *only* two, notwithstanding the often promulgated opinions of theorists, from their very brief and imperfect and disconnected observations, about chinch bugs being many-brooded. The first brood matures from the middle of July to the middle of August, and the second late in autumn. The elder members of the first brood are 20 days in advance of the younger in their development, hence the former commence depositing their eggs for the autumn brood 20 days before the latter begin, hence the fall egg-laying season covers at least about forty days. This makes a difference of 40 days in the development of the second brood, and abundantly accounts for the fact that we

see larvæ, pupa and imago promiscuously together, more especially towards autumn. It is also highly probable that none of the first brood survive the following winter, but that they all lay their eggs and die as does the spring brood. A close observer will, however, notice that of the parent bugs in the spring a very few may be seen among the larva and pupa of the spring brood. Quite probably they are such females as never mated nor fulfilled the great law of their being by propagation, and many of the males, for, like many other insects, the chinch bug lays its eggs and dies.

It is generally believed among entomologists that insect enemies are the most efficient means in nature for exterminating noxious insects; but in this remarkable fact in the history of insects, the great epidemic of 1865 (there can be no doubt about this being an epidemic disease, because the insects died without attaining their maturity), we find a greater enemy, the greatest insect enemy ever recorded, a dreadful "plague," that in a few days almost utterly annihilated a race of beings living in the northern part of the valley of the Mississippi, outnumbering all the human beings that have ever lived on this planet since the morning of Creation.

This disease among the chinch bugs was associated with the long-continued wet, cloudy, cool weather that prevailed during a greater portion of the period of their development, and doubtless was in a measure produced by deficient light, heat and electricity, combined with excessive humidity of the atmosphere, whereby an imperfect physical ("bug") organization was developed. The disease was at its maximum during the moist warm weather that followed the cold rains of June and the first part of July. The young chinch bug spent a great portion of its time on or near the ground, where its body was colder than the atmosphere; hence, upon philosophical principles, there must have been an excessive precipitation of watery vapor in the bronchial tubes. These are the facts in the case, but in the midst of the great obscurity that envelops epidemic diseases among men, it would be only idle speculation to attempt to define the cause more definitely than the physiological laws already observed seem to indicate. At all events it will require many years of warm dry summers, and accompanying winters of plenty of snow for protection, to reinstate the lost innumerable armies of this insect.

During the summer of 1866 the chinch bugs were very scarce in all the early spring, and up to near the harvest I was not able, with the most diligent search, to find one. At harvest I did succeed in finding a few in some localities.

This epidemic disease was not confined to the chinch bug alone. During the summer of 1865 I saw the larvæ of the common striped cucumber bug (*Diabroctica vittata*) on the *stems* of melon and cucumber vines, above ground, a very unusual place for them. Always before this I have found them on the root, beneath the surface of the ground. This unusual position was evidently to escape the effect of some unnatural conditions. During the latter part of the summer of 1865 the imago were very much less numerous than common.

The apple-worm (the larva of *Carpocapsa* (*Tinea*) *pomonella L.*) was very numerous in 1863–4, affecting almost every apple. In 1865–6 they were very much less numerous. From observation I conclude that the disease was produced by the same cause that swept away the chinch bugs.

The potato-worm (*Sphinx quinque-maculatus*) was very numerous in 1864, doing much damage to tomatoes, &c. The pupæ were extremely abundant in the soil in the spring of 1865, but in autumn no observed larvæ had survived.

The *Locustadæ* (grasshoppers) were also severely afflicted; the numerous dead, of all states, were easily seen everywhere, clasping the grass, weeds, &c., in the embrace of death. I might add much more of my observations on these insects, and greatly extend the list of afflicted species, but my object, to prove that epidemic diseases are *incomparably the most* important agents in all nature in destroying noxious insects, has been sufficiently illustrated. Neither is this a mere isolation, for I have observed diseases among various insects for the past 25 years.